MINOS WBS 2.3: Electronics, DAQ and Database

- Status
- Accomplishments since Dec. 2002 review
- Near Detector Electronics production
  - False positive cost variance
  - MENU production
  - Schedule
  - Possible contingency usage

Peter Shanahan
Department of Energy
Review of the NuMI Project
MINOS Parallel Session
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Overview of 2.3 Status

- Schedule Status (BCWP/Total Budget):
  - 89% complete
- Near Electronics: WBS 2.3.1 (Argonne, Fermilab)
  - In production – focus of this talk
- The rest of WBS is summarized below

WBS 2.3 Accomplishments Since December, 2002 Review

- L3 Milestones:
  - WBS 2.3.1.0.MS.6 Begin Menu Card Checkout
    - * completed on time, 4/15/03
  - WBS 2.3.1.0.MS.5 ND Order Production Boards
    - * completed on time, 4/18/03
- Production Started on All Near Detector Electronics Components (Except 2.3.6: VME Timing Module Redesign – 15 units)
  - Fabrication and Assembly for all Printed Circuit Boards
  - Orders issued for All Crates, Power Supplies
- Schedule Logic Improvements (Mostly 2.3.1)
  - More natural logic flow ⇒ more realistic progress tracking

…cont…

WBS 2.3 FD FEE, DAQ, DATABASE

- WBS 2.3.2 Far Detector Front End Electronics (Harvard, Oxford, FNAL)
  - Complete
- WBS 2.3.4 DAQ & Triggering (RAL, Argonne)
  - Far Detector:
    - Final readout crate commissioned in February 2003
  - Near Detector
    - Planning with WBS 2.5 Installation group for ND installation
    - DAQ Code: used at CALDET, daily use at ANL test stand
- WBS 2.3.5 Database (UMinn, Oxford, Fermilab)
  - Gathering module construction data
  - Testing data distribution system
  - Work on implementing Oracle database

WBS 2.3 Aux Systems, DCS, HV

- WBS 2.3.6 Auxiliary Systems (Oxford, FNAL, IIT)
  - Far clock system installation will be completed next month
  - Near clock modules: see below
- WBS 2.3.8 Slow Control & Monitoring (UMD, UWisc, FNAL)
  - Detector Control System: Automatic HV control
  - Rack Protection (RPS)
    - Near: equipment being staged at FNAL, procurement will finish this summer, with assembly to follow
  - Software: HV, Environmental, Magnet, and RPS data now logged to database
- WBS 2.3.9 High Voltage (Texas A&M)
  - Far: HV dropouts traced to bad power conditioner – fixed
  - Near: Power conditioner purchased

Change Requests in WBS 2.3

- CR 218 - $580K overrun (burdened) on electronics
  - Near Detector EDIA : $194K
  - Near Detector Parts Order & Assembly: $129K
    - Fixed Errors in early CR
  - Far Detector EDIA: $82K
  - Far Detector Parts Order & Assembly: $146K
  - Far Detector Production Checkout: $26K
- CR 223 – Schedule Logic Change
  - Gave every task predecessor and successor tasks
  - Thinned out unnecessary predecessor/successor relationships
  - Results: more ‘natural’ production schedule, more meaningful floats
  - $25K increase from escalation

New Milestones

- Level 2:
  - WBS 2.3.0.MS.2
    - Change “Electronics ready for installation – Near” to “Electronics ready to begin installation – Near”
    - Emphasizes pipeline of production and installation
  - WBS 2.3.0.MS.4
    - New: “Electronics production complete – Near”
    - Emphasized completion of all electronics

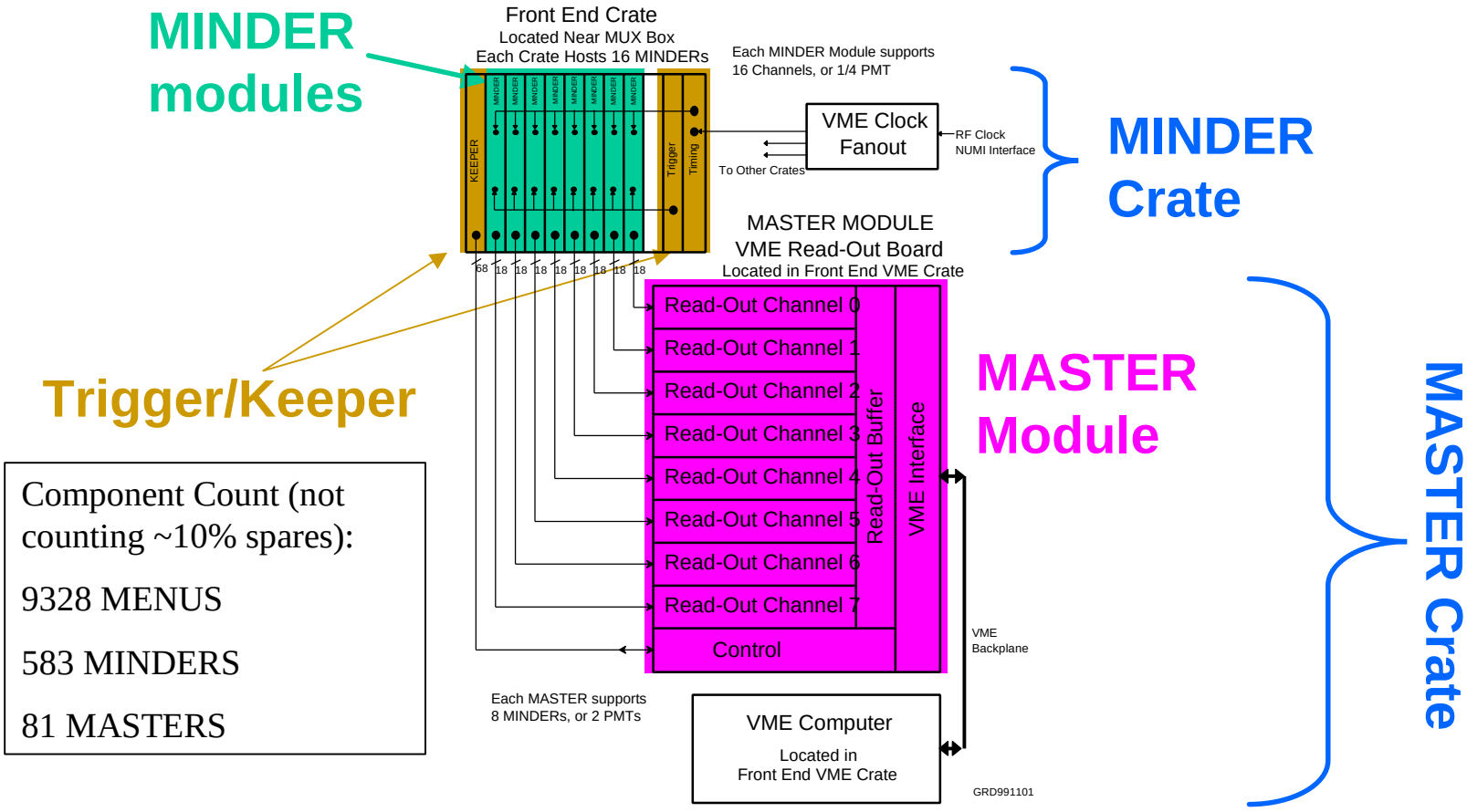
- Level 3:
  - 2.3.1.0.MS.6 Begin MENU Card Checkout
  - 2.3.1.0.MS.7 Complete Shipping for CalDet
  - 2.3.1.0.MS.8 Begin Near FE Electronics Installation

Upcoming Schedule Milestones

WBS	Task	Schedule	Float
2.3.0.MS.2	*Electronics Ready to Begin Installation - Near*	10/15/2003	170d
2.3.0.MS.4	*Electronics Production Complete - Near*	03/01/2004	161d
2.3.1.0.MS.5	*ND Order Production Boards*	04/18/2003	378d
2.3.1.0.MS.6	*Begin MENU Card Checkout*	04/15/2003	113d
2.3.1.0.MS.7	*Complete Shipping for CalDet*	07/10/2003	29d
2.3.1.0.MS.8	*Begin Near FE Electronics Installation*	04/05/2004	198d

Total WBS 2.3 Float is 54 days – partially over-constrained by constant scheduled effort in aiding with electronics installation

Near Detector Electronics



Component Count (not counting ~10% spares):

9328 MENUS

583 MINDERS

81 MASTERS

Near Detector Electronics Status

- Schedule Status (BCWP/Total Budget):
  - 85% March 03 (88% April 03)
- All 2.3.1 system components are in production
  - Problems with MENU startup
  - Minder schedule is tight for CALDET run at CERN
- Artificial Large Favorable Cost Variances:
  - +$1M in March mostly due to “statusing” order tasks
  - Some production orders are under budget
  - Some overruns on labor

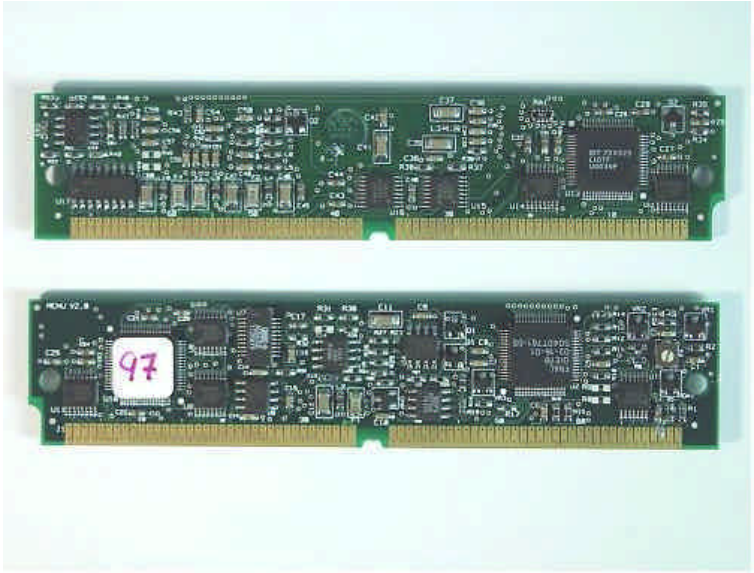
Near Detector Electronics Status

Item	Number for Detector Operation	Number for CALDET Operation	Assembled Number in Hand	Comments
MENUs	9328	1456	1600	90% passing checkout
MINDERs	583	91	10	
KEEPERs	45	8	5	Balance expected week 5/27
MASTERs	81	16	4	7-10 more due 5/21
MINDER CRATEs	45	8	10	
MINDER PS	45	8	10	
MASTER CRATEs	9	2	11	
MASTER PS	9	2	11	
VME Timing Module	10	2	4	Caldet won't use prod. version
Minder Timing Module	45	8	45	~few need repair post-checkout
Master Clock Controler	1	1	3	
Clock Fanout	6	1	7	

Spares (~10%) not included in this table. Various Auxillary cards not included (which have CALDET quantities met).

MENU

- Front-end daughter card
  - Supports and reads out QIE
  - Stores digital data in pipeline
  - 9328 in system
  - 1440 plus spares required for CALDET

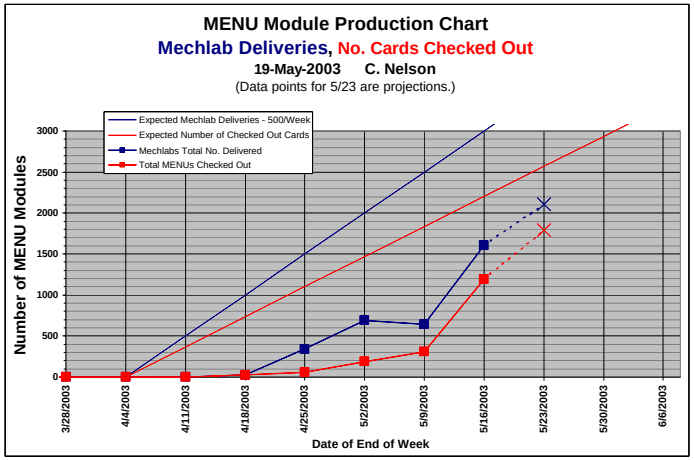


MENU Production Problems

- Sporadic production startup:
- Fabrication
  - Solder on gold contacts – not noticed until fabrication began.
  - Vendor has accepted responsibility: inspection+new boards
  - Vendor inspection insufficient (no microscope on QC line!)
    * Additional Fermilab technician time
- Assembly
  - Incorrect 1st articles
  - Overheated “burn-in” by vendor on 200 boards
  - Poorly tuned initial automated optical inspection by vendor
  - Wrong solder flux on several hundred boards
  - All problems addressed by vendor
    * but with substantial FNAL tech time

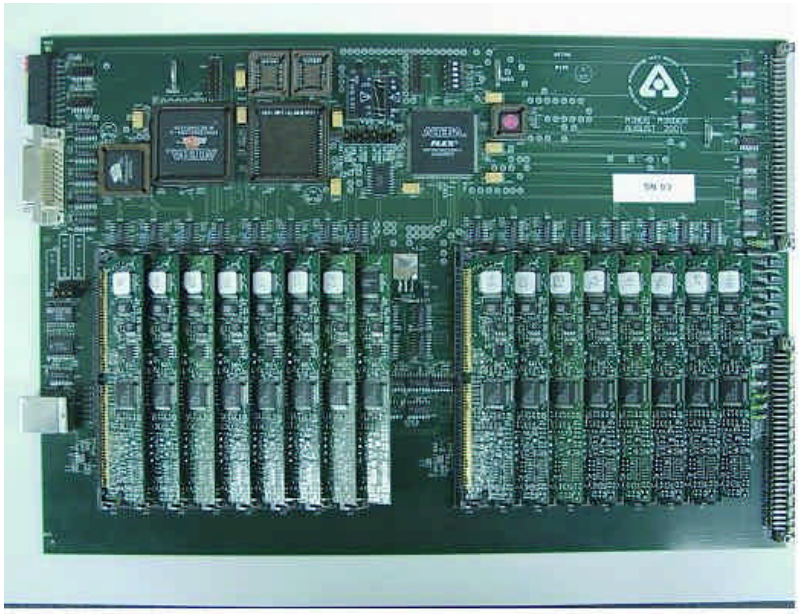
MENU Good News

- 1600 boards in hand
- Checkout rate of boards with no acute problems is >90%
  - Assumed 67% in checkout schedule
- CALDET schedule virtually assured
- IIT Undergrads for Checkout
  - Resident at FNAL for 5 weeks
  - Will later take test-stand to IIT
- Long-term production
  - Rate of 330/wk will complete production by 12/31/03

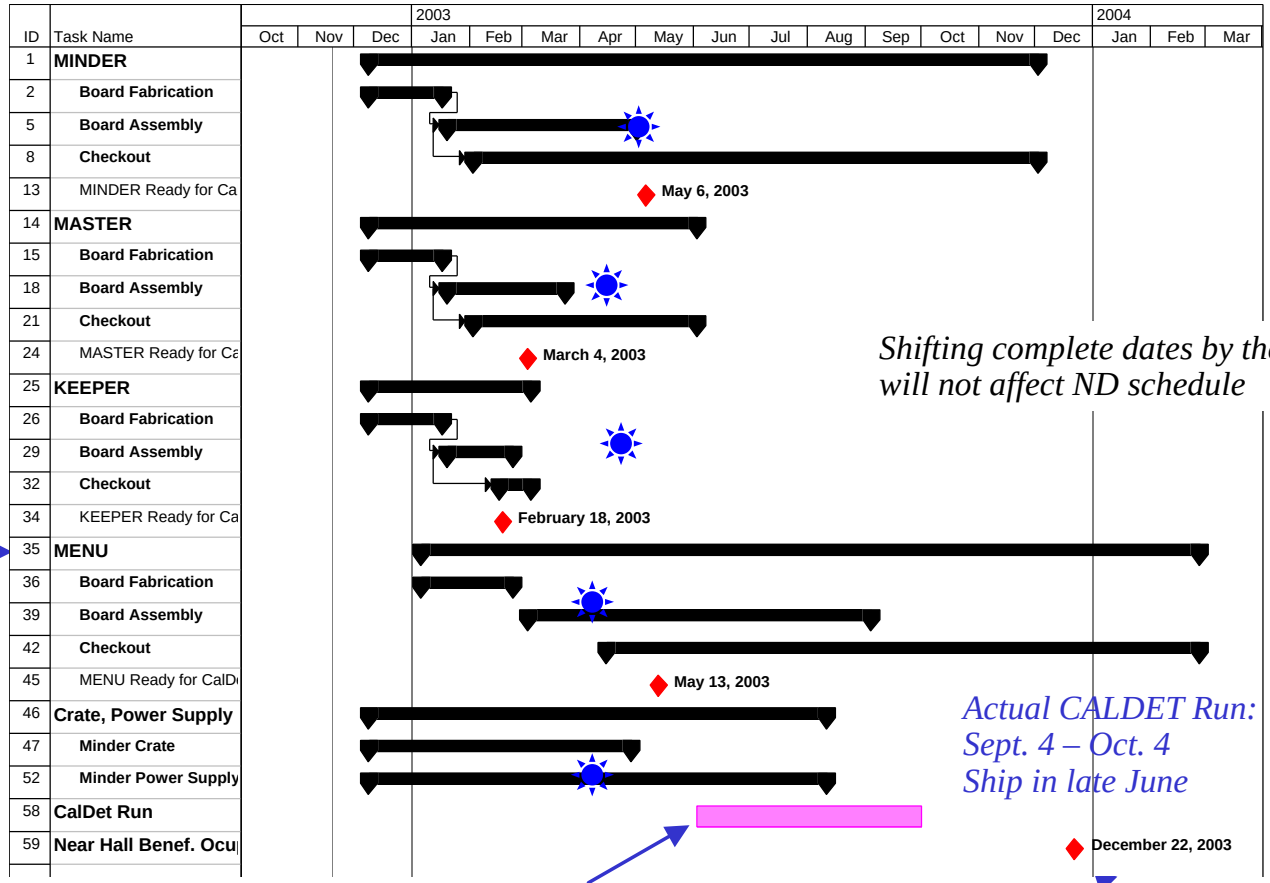


MINDER STATUS

- MENU Mother Board
  - 16 MENUs/MINDER
  - 583 MINDERS in the system
  - 100 needed for CALDET
- Assembly began in early May
- Testing for CALDET
  - >5 modules/day required
  - Run 2 teststand shifts at Argonne
  - Collaborator help for simpler checkout tasks may be used



Near Detector Electronics Schedule (from Dec. '02 Review)



Actual assembly start (fabrication for power supplies)

Shifting complete dates by these amounts will not affect ND schedule

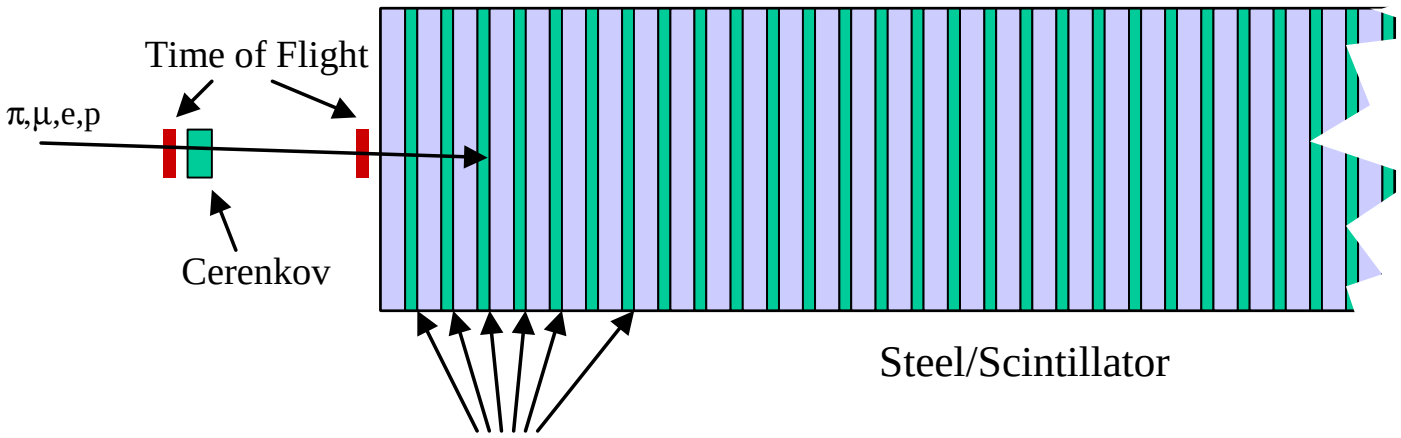
Actual CALDET Run:
Sept. 4 – Oct. 4
Ship in late June

Near Detector CALDET Run – 1500 Channels needed starting June, 2003

Beneficial Occupancy of Near Detector hall – Dec. 22, 2003

CALDET

- Last year's run
  - 150 channels on 1 side had Near Electronics
  - Generally useful system test
  - PID issues and high rate (for Far Detector Electronics) limited ability to compare ND/FD



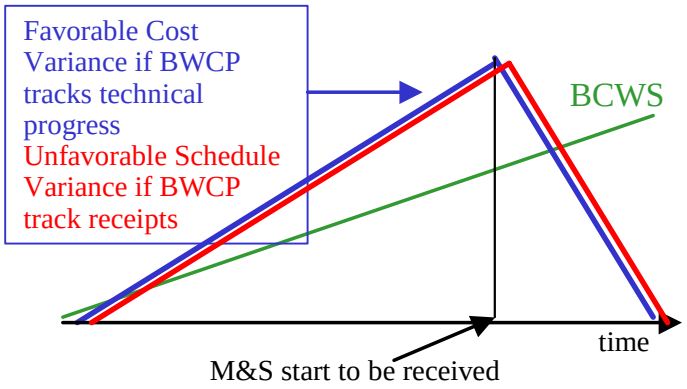
2003 CALDET Run

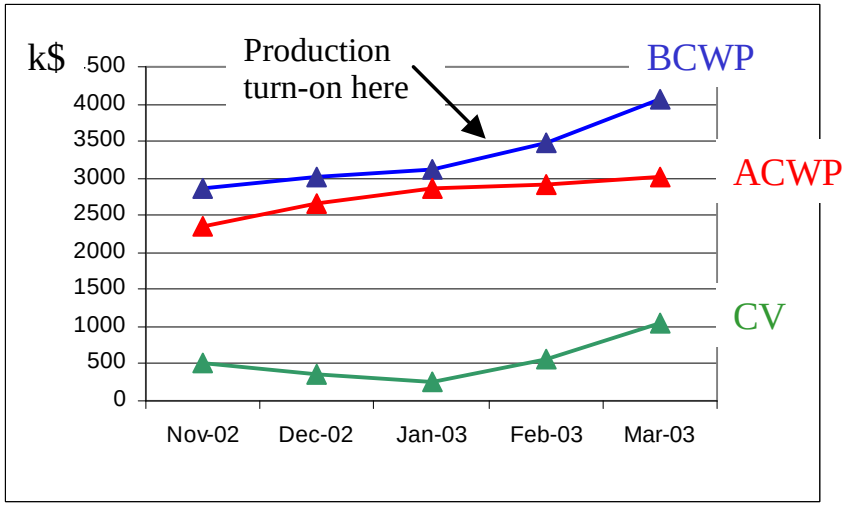
- Sept. 4 – Oct. 4, 2003
- 1440 channels on Near Detector Electronics
  - Full instrumentation of 1 side (actual ND is one sided)
  - Near only, and Near/Far running
- Production calibration of Near response
  - ND Electronics is principle focus of run
- Ship electronics in late June
  - L3 milestone 7/7/03
- Move to beam enclosure 8/26/03

Large Artificial Cost Variance in WBS 2.3.1

- $994 K favorable cost variance
- Two main artificial components:
  - "Order" tasks BCWP based on technical progress, although ACWP doesn't accrue until item is received – *temporary effect*
    - March 03 total 2.3.1 encumbrances=$900k
  - Delays between Argonne activity and Fermilab accounting

E.g.: "order" task including specification, bid solicitation, and purchase





Possible Real Favorable Cost Variances

- Sampling of recent M&S purchase orders:
  - Power supplies, crates, printed circuit boards
  - Possible $100K+ favorable variance
    - * Based on Purchase Order records

Item	Budgeted cost (unburdened)		Actual PO cost	"Variance"
		k$		
MENU Fabrication	73		27	46
MENU Assembly	186		158.5	27.5
VME PS	44		58	-14
MINDER PS	208		246	-38
MINDER Crates	129		60	69
Misc. Board Fab and Assembly	240		168	72
				162.5

Preliminary, unofficial accounting

(excludes PMT cable overrun of ~$20K)

Possible Contingency Use (ignoring possible favorable variances)

- Travel for FNAL engineers: ~$20k
- Tech and Engineer Labor
  - Clock system – possible c. $50k overrun
  - MENU Production
    * Initial fabrication and assembly quality problems being addressed by high-level FNAL techs – possible c. $50k overrun.
    * Will be partially mitigated by general MENU checkout by off-project student labor
- PMT – MINDER cables
  - Issue discovered just before last review: complicated patterns of 64 in to 64 out
  - Fabrication: will be farmed out for $35k, about $20k over budget
- Total currently foreseen overruns for 2.3: $140K

Summary

- WBS 2.3 has had much progress since Dec. 02
  - WBS 2.3.2 finished
  - Steady progress towards completion on DAQ, Database, DCS, HV
  - Near Detector electronics in production
- Artificial large favorable cost variance in 2.3.1
- *Estimates* of real negative and positive variances by sub-tasks in 2.3.1/2.3.6 are approximately both $100-$200k scale
- Actual production appears in line with CALDET run and Near Detector installation
  - CALDET schedule is tight – may require physicist shifts on checkout
- WBS 2.3 is 89% complete